THE METAL INDUSTRY

WITH WHICH IS INCORPORATED THE ALUMINUM WORLD.

A TRADE JOURNAL RELATING TO THE NON-FERROUS METALS AND ALLOYS.

ALUMINUM · COPPER

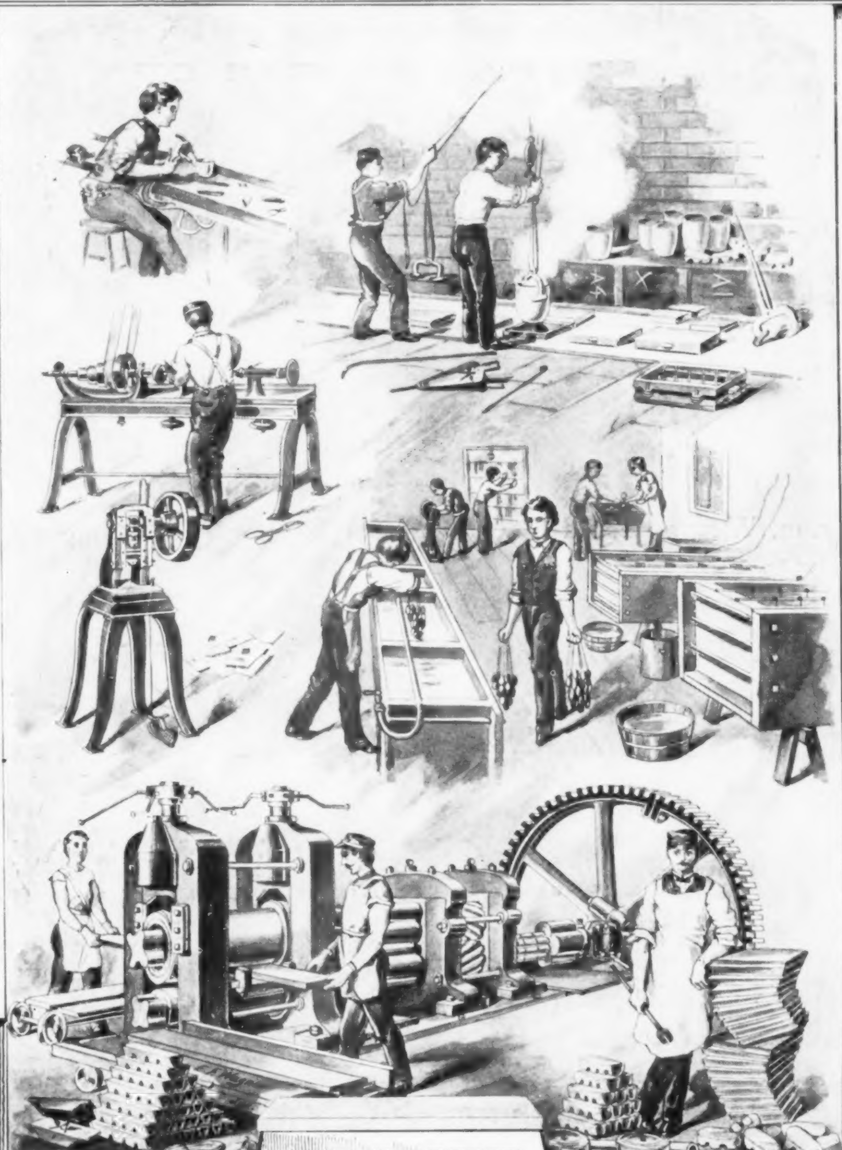
METALLOGRAPHY · BRASS · METALLURGY

NICKEL · SILVER · GOLD

TIN · LEAD · ZINC

ROLLING · DRAWING · STAMPING · SPINNING · TUBE-MAKING · POLISHING ·

MELTING · CASTING · REFINING · SOLDERING · BRAZING · PLATING ·



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JANUARY, 1903

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The Metal Industry

AND

The Aluminum World

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GREETING.

It is with pleasure that we bring before you the first number of THE METAL INDUSTRY. New in title and cover, it is the result of the peculiar condition of affairs which have culminated in the present era; an era of expansion in country, in commerce, and in industry. Keeping pace with this remarkable situation, our journal has undergone a similar transformation. Not one of elimination, however, as might be inferred from casual observation, but the old "stamping ground" remains intact and, at the same time it is represented and new fields entered which are closely allied with aluminum.

Aluminum, once a chemical curiosity, next a valuable metal, then a luxury, has now, thanks to the untiring efforts of scientific investigators and manufacturers, ceased to be such. Cheapened in manufacture beyond the fondest expectations of many, we must now consider it one of the common metals. Rolled in brass and copper mills, cast in brass foundries, drawn in wire mills, and spun, stamped, and otherwise worked on machines originally intended for other metals, it required only ordinary perception to realize that sooner or later aluminum could not be disconnected from the metallurgy of the other non-ferrous metals and alloys. The time has already arrived, we believe, for the complete amalgamation, so to speak, of all these non-ferrous metals and alloys. It is no longer practical to separate one from the other, and for this reason THE ALUMINUM WORLD, without in the least eliminating aluminum metallurgy, has expanded into THE METAL INDUSTRY.

USES OF ALUMINUM.

In this issue we print the first of a series of articles on the uses of aluminum, starting the series with "The Use of Aluminum in Automobiles." We believe that this is the first article ever published giving practical and desirable information on the various aluminum alloys suitable for this work—a class of work for which aluminum is distinctly suitable. The article mentions the best alloys and the uses of sheet aluminum in automobile construction.

OUR SCOPE.

Metallurgy may be divided into two classes: First, the mining, dressing, and smelting of ores or their treatment up to the time that the metal is produced in the metallic state. Second, the manufacture or fabrication of the metal, after it has been reduced from the ore, into the great diversity of forms found in the arts. Various mining journals adequately represent the former class, but the latter, except in the case of iron and steel, has never been properly exploited. It is the intention of THE METAL INDUSTRY, then, to enter this field that it may become the recognized organ. Our scope is the working of the non-ferrous metals and alloys; the casting and rolling, the wire drawing and tube-making, the refining and alloying, the electro-plating and finishing, the stamping and spinning, and in addition we will carefully look after the interests of the dealer and manufacturer, keep him in touch with the conditions of the market and bring to his notice new wares and products which appear from time to time.

Trade and personal notices likewise will be published, and last, but not least, there will be a "Correspondence Department" in which we shall try, as far as possible, to alleviate the sufferings of the patient founder and metal-worker. All questions sent to us will be submitted to various specialists and the questioner may rest assured that the answers will represent intelligent and painstaking work. Accuracy, honesty, and integrity will be our slogan and our earnest endeavor will be to render THE METAL INDUSTRY a journal in which its readers may place the utmost confidence.

METALLOGRAPHY.

Metallography has two particular meanings in its application to the arts. The first is the science describing the chemical and physical properties of metals and alloys. The second, the art of printing from surface or etched metallic plates, the examples of which are algraphy, printing from aluminum, zincography, printing from zinc. Our use of the word will relate to both the printing from metals, and the physical and chemical properties of metals and alloys.

SIR W. C. ROBERTS-AUSTEN.

We regret to chronicle the death of Sir W. C. Roberts-Austen of London, which took place on Nov. 22, at the age of 59 years. As Professor of Metallurgy at the Royal School of Mines and Chemist to the Royal Mint, he occupied a foremost position among the few leaders of metallurgical science and his contributions, especially in the perfection and application of the pyrometer, have been numerous and classic. A treatise on alloys was in course of preparation by him, and it is to be hoped that the work is sufficiently well advanced to preclude any necessity for abandonment. The paucity and unsatisfactory nature of the present works on this subject render his book all the more needful.

METAL PLATED CARS.

We note that the cars to be used in the subway now building in New York city are to be sheathed with copper. The Metal Plated Car and Lumber Company of New York has the contract. The copper is to be left in its natural color; previously it was oxidized. The advantages of the system are protection of the wood against fire and in the saving in the cost of varnishing. Inasmuch as the metal is left in its natural color it would appear that aluminum would be even more suitable than copper, and at the same time cheaper. The method of putting on the sheet is such that neither soldering, brazing, riveting or any similar process is necessary.

In this issue we print a description of Indian repoussé work, illustrated by some photographs which were specially taken for us by the author of the article, Mr. Alfred Chatterton, the Director of the Madras School of Arts.

PURE CYANIDE IN SILVER PLATING.

The cheapness of sodium compounds, compared with those of potassium, invariably tends to lead to the adulteration of potassium compounds wherever it is possible to do so. This has been quite marked in the case of potassium cyanide universally used in the silver plating industry. Although T. B. Stillman states* that for many purposes a mixture of potassium and sodium cyanides is just as good, is cheaper and actually contains a greater available amount of cyanogen (the active principle), certain silver platers, and especially one whom we know stands the very highest in his profession, have arrived at the conclusion that an admixture of sodium cyanide is a very injurious feature. They are so certain of their ground that they are now using nothing but a strictly pure potassium cyanide, free from anything but traces of sodium. Heretofore they had been greatly bothered by the unevenness of the deposit when commercial cyanide was used. Local action took place to a large extent and oftentimes silver would only be thoroughly deposited upon the work in the immediate vicinity of the anode. Why this should be we will not attempt to explain, but we do know that the use of pure potassium cyanide has dispersed these difficulties.

This fact appears also to have been noticed in Germany in gold-plating. R. Kayser states§ that the presence of sodium cyanides forms a difficultly soluble sodium aurous cyanide which is immediately deposited upon the anode.

An examination of 47 samples of so-called potassium cyanide found on the market showed that the average amount of sodium cyanide which it contained to be about 20 per cent. One sample was all sodium cyanide with no potassium, and another contained, in addition to sodium cyanide, 68.76 per cent. of common salt (sodium chloride) and 4.29 per cent. of potassium sulphide.

While for mining purposes the presence of sodium cyanide probably does no harm, in electro-plating such an adulteration should not be tolerated.

*Jour. Analytical Chemistry, 1892.
§Chem. Zeit., 1892, 16-1148.

SPILLY BRASS, ITS CAUSE AND REMEDY

By Erwin S. Sperry.

Is there any one obstacle which gives the brass manufacturer more anxiety and trouble than spilly brass? I think not. Other difficulties are met and vanquished, but spilly brass continues to exist and, I regret to say, its remedy has not made much progress within the last few years. I believe that it will not be overdrawn to say that more trouble is given to the customer by this one fault than any other. Many brass makers may not accept this statement, but when the majority of the difficulties with brass, especially brass sheet, are investigated to the bitter end, spills will be found at the bottom of the trouble. The question may now be pertinent to the case, what are spills and how may they be known? To answer the question requires a complete description of their cause, and let the beginning be made by saying that brass makers usually recognize three kinds of bad metal, viz:

1.—Metal which cracks to pieces in breaking down. It is a difficulty which is produced by antimony, bismuth or arsenic in the copper, too much lead in the alloy, too high a temperature in pouring, or similar conditions.

2.—"Spuey" Metal. This term is not used to any great extent in this country, although the difficulty exists just the same. In England, where the term originated, it is extensively used, but in the United States the name of "Pin-holes" or "Blowholes" is employed. As far as known, "Spuey" metal is caused by the presence of blowholes. In the plate which has been cast but not rolled the real blowhole may be found. Usually no larger than a pin's head, they are slightly elongated and exist, from the fact that they are imprisoned gases, in much larger numbers in the top of the bar than in the bottom. When the plate or bar is broken down in rolling they become slightly elongated and the finished sheet contains them in the shape of streaks. When the sheet is annealed the gases, compressed during the rolling, expand and form blisters. Those on the surface, of course, are the only ones which produce blisters, while the others are revealed when the metal is dipped, polished, spun, or stamped. In spinning, the fact that the metal around the blowhole has not become welded during the rolling, makes the sheet tear apart during the operation. In drawing the same difficulty exists. In dipping the acid remains in the blowholes, and sooner or later acting upon the metal produces unsightly spots, either on the lacquered or polished surface. Although "spuey" metal exists to a considerable extent, many of the uses to which brass is put are such that the existence of minute streaks or imperfectly united metal does not interfere. This is particularly true in the case of hard-rolled or hard drawn metal. Blowholes, unless present to an enormous extent, do not interfere with the proper use of the material. Such a condition of affairs is, however, responsible for the existence of alloys known as spinning, drawing, or dipping brass; materials which do not differ in composition from many other ordinary brasses, but upon which care has been taken to avoid blowholes or other imperfections.

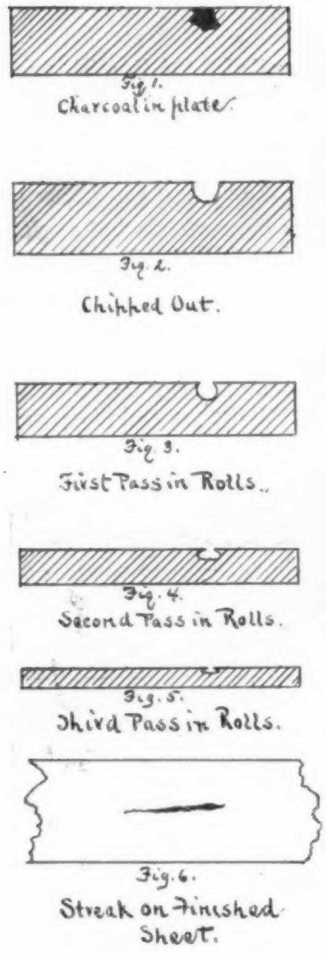
"Spuey" metal may be caused by several conditions, chiefly, however, the fact that the metal was not kept completely covered with charcoal during melting, or that it was allowed to overheat or "soak" in the fire. "Spuey" metal is often mistaken for that which is spilly, although erroneously, for the cause and effect is quite different.

3.—"Spilly" Metal. As previously stated, this is the main source of trouble in brass making. By it is meant imperfections of various kinds which are produced by the presence of charcoal, dross, oxide, or other foreign matter in the plate or bar before it is rolled. Of English origin the term "spilly" is apparently derived from the fact that brass, in order to be satisfactory, should be poured into the mold in a steady and uninterrupted stream. If the metal is poured otherwise or "spilled" unsound castings are produced. Now let us realize what will happen if the brass caster is lax or slovenly in his methods and neglects to thoroughly skim the crucible before the metal is poured. Charcoal, of course, is present on the surface and is quite difficult to entirely remove unless careful attention is paid to it. Usually in a hurry to get his heats out the skimming is not too well done and more or less charcoal goes in with the brass. It is the common argument of the caster that the charcoal will float to the top and is removed

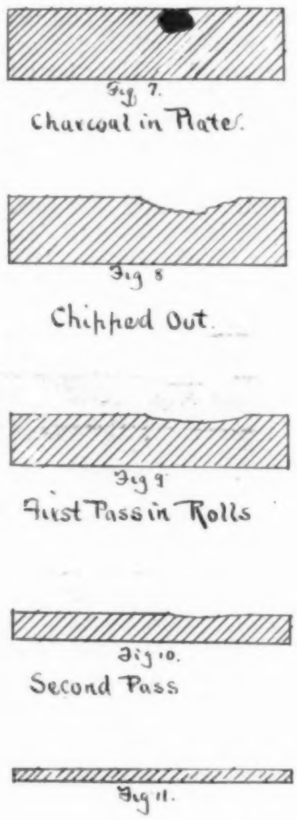
A BRASS CASTER.

when the gate is cut off, but such is rarely the case. Charcoal generally sticks to the sides or edges of the mold and requires to be chipped out with a cold-chisel. Indeed, charcoal is often found in the extreme bottom of the plate. One might possibly think that these small bits of non-metallic material would give no harm and, indeed, they will not, barring the labor which it takes to chip them out, if their removal is properly done. The charcoal which sticks to the surface is of considerable size, so that a hole of some magnitude is left in the plate. The chipping of the plate is usually done with the least possible labor, and after it has been completed the hole has the appearance of Fig. 2. When the next pass or breaking down is given it the edges of the hole begin to curl over with the formation of a lip, as indicated in Fig. 3. In Fig. 4 the lips are still further compressed, and in Fig. 5 they are nearly flattened out. When the sheet is finished a streak is invari-

Sections of Brass Plate Showing Bad Method of Chipping.



Proper Method of Chipping Brass Plate.



ably found in the plate, such as shown in Fig. 6. Such a condition exists whether the foreign material be dross or charcoal, and the brass which contain the streaks is always called spilly brass. The chipper should be impressed with the fact that a plate does not widen much in rolling and that cross rolling will produce the lips on the sides as well as the remainder of the edges. The proper method of chipping out foreign matter is shown in Figs. 7 to Figs. 11. The cavity should be dished as much as possible, so as to allow the metal to be compressed in the opposite direction from that indicated in the other sketch. In a properly chipped hole no indications of its existence will be noticed in the finished sheet. Another feature which requires care is the avoidance of ridges left by the chisel with each successive blow of the hammer. More "chatter" marks than otherwise, perhaps, these little imperfections do not roll out, but may be readily detected on the finished material.

The cavity which is left after chipping should be perfectly smooth. It has often occurred to me that some sort of a tool, similar perhaps to a countersink, might be useful in removing charcoal, but this would be attempting a remedy for a condition which should not exist, and is only caused by carelessness.

With the charcoal other matter goes into the mold; scale from the crucible, coal and dross. If the caster is lax in skimming the crucible large amounts of the latter will enter the mold, and, like charcoal, will stick wherever it happens to lodge. Overhauling, to be sure, removes that portion which may be on the surface, but the majority intermingles with the metal, and no amount of scraping will remove it. It is "inherent in the flesh" and the best remedy is to cut the plate up and remelt it. This the brass maker is loathe to do, and many times much labor is wasted and poor sheet produced by not following this method. Large patches of dross contain just enough metal to render them coherent and so stand the rolling, but that is all. Gross carelessness in skimming the crucible is the reason for their existence.

Dross is the accumulation of the products of oxidation while the metal is being melted, and, when thoroughly skimmed off, there is invariably a thin film of oxide left on the metal. As fast as this is removed more is formed *ad infinitum.* Now let us pour the metal at the proper heat into a mold which has never had oil put upon it and notice the result. The plate will be found to be very dirty all over; not in large patches, as is the case of slovenly pouring, but more or less evenly distributed. This condition is caused by the oxide flowing in with the metal and, intermingling as it flows, produces dirt-like imperfections. Overhauling will remove it superficially but, although the sheet may appear clean to the naked eye, the spinner, cartridge-maker, or polisher will surely detect it. The oxide prevents the perfect uniting of the metal, and when such an operation as spinning takes place the metal tears apart at whatever place the imperfection may exist.

(To be Continued).

PURE AND ALLOYED LEAD.

Lead is used to a considerable extent in the brass and copper industry for lining pickle tanks. These tanks hold diluted sulphuric acid (oil of vitriol); about 10 per cent. is used. It has been an open question whether pure sheet lead or that containing a small amount of antimony or copper is best adapted to the work. Dr. Lunge, of Switzerland, has recently investigated this subject and arrived at the following conclusions:

1.—There is no difference in the cold between the actions of sulphuric acid on pure and antimonial lead when the amount of antimony does not exceed 0.2 per cent. When hot, pure lead resists better than the alloyed.

2.—The admixture of a small percentage of copper does not increase its power to resist the action of sulphuric acid in the cold. When heated there is a slight advantage in favor of the copper alloy.

CASTING ZINC IN METAL MOLDS.

The casting of zinc in metal molds is an industry of considerable magnitude; much greater, in fact, than most people suppose. The fancy designs in lamps, vases, and other ornamental ware is made from zinc castings, and it is well adapted for the purpose. One requirement for the successful performance of the casting process, however, is the necessity of using pure zinc. Common spelter will not answer as its hot-shortness is such that it invariably cracks during contraction. Bertha zinc or its equal is what is generally used.

A method of strengthening copper steam pipes by means of coiled metal wire is described by Nabor Soliani, in the *Revisitta Marittinia.*. The pracetice is to serve the tube over with one or more layers of closely-laid metal wire, wound on under tension. Drawn tubes up to about eight inches in diameter are made out of copper sheets by brazing in the usual way, and are then wrapped round with a close spiral of copper or Delta metal wire. We understand that this method has been adopted in the Italian Navy.

THE USE OF ALUMINUM IN AUTOMOBILES

It is quite natural that the automobile manufacturer should turn to aluminum. Driven by necessity to the use of light materials he cannot do otherwise than to accept the inevitable of "Hobson's choice." His case is quite different from that of the bicycle manufacturer who, in the early history of the industry, likewise became much interested in and experimented with aluminum to a great extent. The bicycle maker, however, is quite limited in his construction; the joints must be brazed, the bearings must be glass hard, the sprocket and chain require extreme strength and spokes are now made of steel piano wire, the strongest of all known substances which has a tensile strength of 300,000 pounds per square inch. It may be seen readily, therefore, why aluminum made no foothold in the bicycle industry.

The automobile question is quite different, although in this case brazed frames, steel sprocket chains and spokes are used, there are numerous other parts which the bicycle does not possess, but are really fundamental to the very existence of the machine. Complicated parts which only can be made of sand castings are present in every machine, and it is in this requirement that aluminum is valuable. Many, perhaps, might inquire why cast iron should not be exclusively used on account of its cheapness and capability of being cast. An answer to this question embodies several parts, viz: these castings are necessarily made light, and the actual weight of metal in them is of little consequence. Like a steel die upon which a die-sinker spends a month of labor on five pounds of unwrought steel, so it is with these automobile castings; the labor is by far the greatest item. It is, therefore, quite natural that aluminum should be used for such a purpose. Cast iron, again, possesses no ductility or "give," as it is usually called, and the least strain or accident tends to rupture it. Automobiles have no extra weight put upon them to guard against strains of such a nature, but are purposely made more or less flexible so as to guard against rupture in cases of severe strain. Cast iron accordingly is dangerous to use where breakage is liable to occur; with aluminum the case is different, for the fact exists that the alloy may be made either hard or soft or in all intermediate conditions. Cast-iron is also difficult to cast satisfactorily in the usual complicated shapes of the automobile casting. Its high melting point prevents the satisfactory running of the metal in thin places. Cracks are very liable to appear from strains in cooling, and last, but not least by any means, is the hardness of chilling produced by the wet sand. Such chilling is liable to occur in the cast-iron castings when made in green sand; especially when the molder swabs down the corners of his mold or patches a "drop" and does not dry the patch of wet sand so as to conform to the rest of the sand. Hard iron castings are the most unsatisfactory condition of the machine shop, and we know that it is unnecessary to dwell longer on this point. Aluminum castings are entirely free from such a condition, and it is in these difficult requirements that aluminum is used.

The present use of aluminum in automobiles appears to be limited to the castings for gear cases, engine castings, washers and sheet for bodies and mufflers. One automobile manufacturer states that he has tried aluminum for bearings, but it was unsatisfactory. And so it is; iron, soft steel, copper, common brass all make unsatisfactory bearing material. It is an axiom that soft metals do not make good bearing surfaces, and for this reason all aluminum alloys are unsuited, which are used for tough and strong castings. For bearings a peculiar alloy good for nothing else is necessary. Inquiry among most of the leading automobile manufacturers resulted in the fact that many of them are now using aluminum and with satisfactory results. Others have not yet investigated the matter and some state that they would gladly use aluminum if certain requirements could be met. Extracts from their communications are as follows:

"We wish to advise that we use aluminum for the manufacture of gear cases and crank cases, and in many places for washers and shims. In these places it answers perfectly. We have found that it does not make a good bearing metal. In other instances where we have used it we have had excellent results."

"Will say that we use quite a bit of aluminum in the construction of our motors, all of which is in the cast state, and has proven entirely satisfactory for the purpose for which we have used it."

"We are pleased to inform you that our experience, up to the present time, with castings made from aluminum alloys has proven very satisfactory. We find that pure aluminum castings do not meet the requirements, but the alloys of it give good results. We have also used considerable sheet aluminum with satisfaction."

"In the matter of castings those which we use have a very high tensile strength, and in fact much stronger than the usual run of aluminum alloys. Up to the present time we have experienced no deteriorating effects, atmospherically or otherwise, and in general we are very well pleased with the results."

"Would say that we have not used aluminum to any great extent, but are now experimenting with it for engine frames. Should be glad to know of any alloy which will give us a strong light metal, one that can be easily machined and not too expensive."

"Replying to yours in regard to aluminum, we have not yet used aluminum in the construction of our machines, but believe we could if it were possible to obtain a strong light alloy. We have not tried any alloys at all and know that others are using it. Kindly give us what information you can about it."

"We are at present using aluminum crank and transmission cases made of Pittsburgh Reduction Co. No. 4 metal which has given us good satisfaction, machining perfectly without the aid of turpentine or other assistance and makes very fine clean castings, being firm enough and tough enough to withstand drilling and tapping."

The quotations are given to illustrate the general prevailing opinion of aluminum among automobile manufacturers. We believe that aluminum has made a firm foothold in the construction of the machine, and that those who do not use it or who have difficulty in casting or working it only need enlightenment to bring them into the multitude of believers. One manufacturer asks what proportion of cast iron it is necessary to melt with the aluminum; another the amount of bronze. Others ask for information about casting. The answers to these questions as well as other information are embodied in the following remarks, viz:

Cast iron is quite unsuited for alloying with aluminum and bronze, also it is unsatisfactory. The alloys now used for castings may be divided into two classes, viz:

1.—Those in which the aluminum is alloyed with small amounts of copper or copper and other metals. The combined amount of the alloying metals is usually about seven per cent., and if copper alone is employed, this seven per cent. alloy makes a very satisfactory material. Not as strong as the aluminum-zinc alloys, it is, however, sufficiently so for most requirements. The redeeming feature about the alloy is the fact that it casts remarkably

well, even better than pure aluminum itself. Very complicated shapes, which, made of the aluminum-zinc alloy, would crack, can be easily cast from this. On account of the small quantity of the alloying material the alloy is much lighter than the aluminum-zinc alloys. Successful casting, like any of the aluminum alloys, requires care in melting and what applies in the next paragraph to the casting of the aluminum-zinc alloys applies equally as well to the aluminum-copper compounds. If seven per cent. of copper gives an alloy which is not tough enough, then four, five or six per cent may be used, depending upon the requirements. The seven per cent. alloy, however, is the one generally used for work requiring a stiff metal. Those who do not care to make the alloy themselves may purchase the Pittsburgh Reduction Company's nickel aluminum casting metal and obtain the same results as with the copper alloy. By melting this with pure aluminum the quality of the alloy may be altered. Both these alloys will give a tensile strength of between 15,000 and 20,000 lbs. per square inch in the average sand casting. If great care is used much higher tensile strength may be obtained. Those who experience difficulty in casting aluminum-zinc alloys should try this class of alloys. If a pattern cannot be cast from them something must be wrong with the pattern.

2.—Alloys which consist of aluminum and zinc. These are quite attractive to the foundryman on account of their strength and cheapness. However, if not properly cast they are very unsatisfactory, and under poor casting conditions come out of the sand in a much weaker condition than the aluminum copper alloys. For ordinary use an alloy consisting of three parts of aluminum and one part of zinc (75 per cent. of aluminum and 25 per cent. of zinc) is the best. If it is desired to make the alloy from new metals the Pittsburgh Reduction Company's No. 1 aluminum may be melted with the correct amount of zinc. Scrap aluminum may be used in the form of skeleton sheet. On no account should chips or a miscellaneous assortment of scrap castings be used. We have obtained excellent results in the use of skeleton sheet and ordinary spelter. Refined spelter is unnecessary. If properly cast a tensile strength of 35,000 lbs. per square inch may readily be obtained on small green-sand castings. In order to obtain it, however, the following precautions must be carried out to the letter; otherwise a tensile strength varying from 10,000 to 15,000 lbs. per square inch will be the results.

1.—Don't overheat in the fire. As soon as melted and at the proper temperature remove and pour. A common fault in the shop is to have the metal melted before the molder has finished his molds. This necessitates holding the heats and such a condition is very injurious to the quality of the metal.

2.—Pour at the lowest possible temperature at which the casting will run. This precaution is the most essential of all for the hotter the metal the lower the tensile strength of the casting. A phenomenon of this kind explains the great diversity of results obtained in the strength of aluminum castings.

3.—Skim thoroughly before pouring.

By observing these precautions, and especially in regard to the temperature, the difficulty of making strong aluminum castings will be greatly diminished. By pouring two test bars from the same crucible, one at a bright red heat and the other at the lowest possible temperature, we have obtained results on test bars which varied by nearly one hundred per cent. The bar poured at the bright red heat was only about one-half as strong as the other.

Now about the pattern. Herein lies one obstacle with which the aluminum foundryman has to contend. If the aluminum-zinc alloy is to be used the corners should not only be filleted, but even rounded as this alloy is apt to draw in or crack in such places. The ribs and other portions should be well proportioned for, as previously mentioned, good work requires a low pouring temperature, and unless the pattern is so constructed the casting will not be completely "run." The thick portions will take all the metal before it has a chance to fill the thin places. Risers should be put on all heavy parts, and as many gates as possible should be used. The gear cases of an automobile are usually very complicated patterns to mold, and especial care must be given to the core. If made in green sand or if the pattern makes its own core arrangements must be made for allowing it to contract when the metal is cooling. In the case of a dry sand core the same rule applies, but, of course, the core can be made "rotten" by means of rosin or similar compounds. A hard, unyielding core means a cracked casting.

Many founders begin to loosen the sand as soon as the casting has set, but this practice requires great care; otherwise the casting may be strained by the loosening bars. In the casting of a large gear case for an automobile as much of the pattern as possible should be molded in the nowel, as the metal will then flow down instead of over the core as it would have to do if cast in the cope. There is an aversion to this, we know, but many castings, on account of their extreme thinness, cannot be cast in any other way. We have cast many automobile cases in this manner, poured them with four pots and loosened the sand after the metal had set; the results were usually good, though as in any similar work, we occasionally lost some. The "wasters" were usually those which did not run, although we occasionally had a cracked one. Our attempt to pour the metal at a very low heat rendered it difficult to have them run. We advise those who are experimenting along this line to use every means within their power to pour at a low temperature, as the tensile strength is then high and the alloy less liable to crack. Dry sand molds greatly aid the running of a difficult casting by preventing the metal chilling as rapidly as it would in a green sand mold.

The use of sheet aluminum in automobiles is a matter that the maker need have little difficulty about. Sufficiently strong sheet is now readily obtained and for panels, bodies and muffler jackets it cannot be surpassed. Nearly as light as wood could be made with the same strength it has the advantage of being fireproof; a quality which by no means is to be overlooked. The fireproof automobile will, in the future, be more real than is anticipated.

THE RECOVERY OF TIN FROM TIN PLATE SCRAP.

Large quantities of tin plate scrap are produced in the manufacture of tin cans and similar goods. The scrap is iron with two or three per cent. of tin on the surface. Much thought has been given the reclaiming of the tin from it, and many patents have been issued. Mr. Swinburne, of London, an authority on electrolysis, says that it is an easy matter to remove the tin by means of the electric current and a solution of caustic soda, but there is practically no material to work on. Although large quantities of scrap are annually produced there is none for sale.

This statement appears paradoxical, and we are interested to know (and ask our readers to inform us) whether the tin plate scrap produced is used for the iron it contains, for the tin, or for both.

CASTING COPPER IN SAND

To the uninitiated the casting of copper in sand appears to be quite a simple operation. All that it seems necessary to do is to melt it in a crucible, and, when at the proper temperature, pour the molten metal into the casting. Let us try this and learn whether it is such a simple operation after all.

The copper ingots are placed in a crucible, and when they begin to melt charcoal is added. When the requisite temperature has been reached the pouring is done. As the novice usually fears that he will not get his metal hot enough, let us assume that the copper is at a bright red heat. The pouring takes place readily, if the casting which is to be made is of sufficient size, and for a few seconds there is a period of quietness and then, provided the heat has been somewhat prolonged in the fire or "soaked," as the term is often applied, the sand is blown from the flask and the metal at the gate flies in all directions; in fact, a small explosion has taken place. When the casting is inspected it may or may not bear any resemblance to the pattern; usually it does not, but simply presents an appearance of a jagged mass of metal.

We presume that nearly all foundry men have had this same experience, and from such a phenomenon is derived the common expression that "Cast copper will explode." Of course, while this statement is true when qualified, it must not be taken literally, for a pile of copper ingots presents no more explosive properties than so many doughnuts. It is an actual fact, however, and one which we have seen occur many times, that copper will explode when cast in sand, especially if the heat be high and the length of time which it remains in the fire be somewhat prolonged. The casting must be done in sand, however, for it does not occur in metal molds. Dry sand is even more apt to bring it about than green sand, probably on account of the slower cooling. So much for copper which has been overheated.

Now let us try again, but carefully avoid overheating. When the proper temperature has been reached we will immediately pour into the mold. There will be no explosion in this case, but instead the sand in the cope will be seen to rise and break away. The metal at the gate will swell up and liquid copper will continue to ooze out for some time. The whole phenomenon indicates that an action is going on inside the mold. When the casting is inspected a peculiar state of affairs will be noticed. Instead of shrinking the casting will have swelled so that the dimensions are actually larger than those of the pattern from which it was made. Numberless blowholes, large and small, fill the interior, and, of course, the casting is worthless. Pour the casting at any temperature you may; melt with coal, coke, oil, or gas, cast in green sand or dry, coat the mold with anything you may please, and the result will be the same. The only difference will be in the number and size of the blowholes; if the heat be kept down they will be less than when a high temperature is used. Pure copper gives worse results than impure. It is not surprising, then, that there has been for years a saying that "Copper cannot be cast in sand."

This abnormal condition in the casting of pure copper in sand is easily explained. When melted it absorbs oxygen gas and another called carbon monoxide (CO). Although apparently condensed while in the molten metal they are given off again when the mass slowly cools. These gases, therefore, form blowholes, large or small, depending upon the amount which the metal contains. The longer the metal is in the fire or the hotter that it is heated the greater is the gas absorption and, consequently, the more numerous the blowholes.

How to get rid of blowholes has long been the problem of the foundryman, and it has been solved, as far as copper is concerned, by the use of silicon. Various fluxes such as glass, fluorspar, borax, etc., have been tried, but they only act as a protective covering, and practice has shown that their action is very irregular and uncertain. Silicon, however, invariably acts the same as it actually becomes a part of the metal and is invariably introduced in the same amount. Its action, although called a flux, is radically different from the ordinary meaning of the term. Let us discuss the action of silicon when added to copper that the true nature may be appreciated. The affinity for oxygen is the cause of its value, and it is so great that not only is the oxygen absorbed, so to speak, but the carbon monoxide decomposed and carbon set free. Silicon, when it combines with oxygen forms silica (SiO_2) the familiar forms of which are quartz or sand. Silica, being a solid, rises to the top of the metal and simply acts like so much dross and may be easily skimmed off. The same reaction occurs when the carbon monoxide is decomposed except that carbon is liberated in the form of graphite. It is this property of uniting with the gaseous oxygen and carbon monoxide and forming solids that renders silicon valuable in the casting of pure copper. In this respect it acts with more vigor than phosphorus. While the latter will absorb the oxygen it does not decompose the carbon monoxide; hence some uncertainty exists in its use in copper casting.

The demand for copper castings of high conductivity for electricity is rapidly increasing, and while the average founder shuns orders of the kind, the use of silicon (we should say proper use, perhaps) should dispel all fear of not getting sound work. Pure silicon, except as an expensive chemical, is not sold on the market and, paradoxical as it may seem, does not work well. It exists as a fine powder which easily oxidizes when heated, coating each particle with a film of silica which prevents its alloying with the metal. Were silicon cheap enough it would not be used on this account. For this reason an alloy of silicon and copper called "Silicon-Copper" is employed. The percentage of silicon being known, the proper amount may be readily introduced into the metal. It is made by heating sand, charcoal and copper in an electric furnace, and as soon as the silicon is reduced by the charcoal it combines with the copper forming the alloy. This alloy is afterwards analyzed and the exact amount of silicon determined.

If copper castings of high electrical conductivity are desired the ingot copper from which they are to be made must likewise be of high conductivity. Antimony, bismuth, iron, arsenic and other elements which lower the conductivity of copper are not removed by silicon, and hence low conductivity ingots mean low conductivity castings. This is an important point and must be adhered to. Add 1 lb. of silicon-copper, containing 10 per cent. of silicon, to 100 lbs. of copper. While this amount seems small, it will be sufficient if great care is taken to keep the copper well covered with charcoal and to avoid overheating. After adding the silicon-copper stir well with a plumbago stirrer and allow to remain in the fire for a short time so as to give the silica which has been formed an opportunity to rise to the top. Then skim and pour. Large gates and risers on the thick portions of the castings must be used for the copper will be found to shrink somewhat, indicating sound metal. The proper heat for pouring can only be found by practice, as it varies with the casting. The temperature should be much higher, however, than that of brass, as copper chills easily. If the

electrical conductivity is not a desideratum, but soundness is all that is required, it is advisable to increase the amount of silicon-copper to be added to 2 lbs. per hundred instead of 1 lb. as before. This will insure to a greater extent the absence of blowholes.

Success in this work requires the following precautions to be taken:

1.—Use a new crucible and preserve for this work. Any contamination with brass, bronze, aluminum, or other metals or alloys will lower the conductivity.

2.—If high conductivity is desired use only copper of high conductivity. For other work ordinary copper or scrap will do.

3.—Use only plumbago stirrers and skimmers; iron is rapidly attacked by silicon.

4.—Keep the metal well covered with charcoal. Put some in the crucible with the metal and when it begins to melt add more. The addition of charcoal is one of the necessary conditions for success.

5.—Don't overheat the copper. When at the proper temperature, immediately remove and pour. "Soaking" in the fire or allowing it to remain for some time, even though the temperature may not be high, is to be avoided.

6.—After the silicon-copper has been added stir and then allow to remain for a few minutes so that the silicia may rise to the top.

7.—Cast the pattern with the finished side down. As gases are lighter than metal, blowholes invariably rise to the top. The side which is to be finished, therefore, should not be at the top.

8.—Do not pour the metal at too low a temperature. The casting will not "run up" sharply if you do, and is liable to become "drawn"; (i. e., containing shrink holes).

9.—Do not imagine because silicon will prevent the existence of blowholes that the process can be abused. In order to get the best results all the above precautions must be taken.

CASTING NICKEL IN A CUPOLA.

The manufacture of nickel anodes is confined to a few concerns in the United States, although the consumption of nickel in nickel plating is quite large. The magnitude of the anode industry may be realized from the fact that heretofore nickel has invariably been melted in crucibles preparatory to casting it into anodes. H. L. Haas, of the Zucker, Levett & Loeb Company, of New York, has invented a process for melting nickel in a cupola in a manner similar to cast iron. Many advantages are claimed for this process, among which are the following, viz.: Crucibles are entirely dispensed with. Heretofore they would only last two or three heats in melting the nickel. Much less cost for fuel. The elimination of carbon from the nickel. A nickel anode of a higher degree of purity than hitherto obtained is said to be made by the process.

ANTIMONIAL-LEAD.

This is an alloy which in former times was difficult for the makers to sell. A by-product in the smelting of silver, it was only until its use in the manufacture of anti-friction metals was begun that it commanded a higher price than pure lead; heretofore its price was lower.

The following analysis was made on a commercial grade and will, it is believed, be of interest as few analyses of this material have found their way into print:

Lead	71.52 per cent.
Antimony	21.05 per cent.
Arsenic	6.38 per cent.
Copper	.74 per cent.
Iron	.31 per cent.

REASON FOR CORROSIVE ACTION OF SEA WATER ON YELLOW METAL (MUNTZ METAL).

It has long been known that some varieties of yellow metal are corroded by sea water much more rapidly than others, but the reason for it has heretofore not been understood. E. A. Lewis* has investigated the subject and arrived at some valuable results. He examined a large number of samples of sheathing which had worn away quickly, and also some which gave excellent results. The composition of the yellow metal (Muntz metal) which he examined contained from 60-62 per cent. of copper and 38-40 per cent. of zinc. His investigations show, strange to say, that chemically pure yellow metal, or that made from pure copper and spelter, is rapidly attacked by sea water. When about 0.20 per cent. of iron or nickel is present the alloy resists the action much better than when only copper and spelter are present. When about 0.20 per cent. of tin, arsenic or manganese is present the action of the sea water is still less than even when the iron or nickel exists in the alloy. Lead does not appear to make the metal better for resisting the sea water, and all the samples of the yellow metal which he tested contained from 0.10 to 1.00 per cent. of this element. His conclusion is, viz.: That yellow metal which does not contain a small percentage of tin, arsenic, manganese (or, although not as good, iron or nickel) is unfit for use as ship's sheathing or similar purposes.

[This investigation explains the reason for the fact that such alloys as Tobin bronze, manganese bronze, delta metal, Bulls metal, or other similar mixtures resist the action of sea water better than the commercial varieties of yellow metal. The former, while they consist of the same proportions of copper and spelter as yellow metal, contain, in addition, either a small proportion of tin, manganese, or iron which apparently renders them more non-corrosive than those mixtures which are free from them. This fact, coupled with that in regard to keeping the lead down as much as possible, is of much value to the brass industry, as it indicates the best composition to withstand the action of sea-water.—EDITOR.]

TOBIN BRONZE VS. STEEL.

Recent advices state that the new cup defender now building in the United States by the Herreshoffs of Bristol, R. I., is to be sheathed with Tobin bronze in the same manner as its predecessors, the Constitution and Columbia. On the other hand, the Shamrock III. is to be plated with steel instead of Manganese bronze, the alloy used on the Shamrock II. The metallurgical, as well as the sporting world, will watch with much interest this battle of metals.

BENDING COPPER PIPE.

A correspondent in an exchange speaks as follows in regard to bending copper pipes:

"Many coppersmiths fill the pipe to be bent with dry river sand, plugging up the two ends tightly with well-fitted wooden plugs. The sand prevents buckling and makes a filling almost as good as rosin, without the danger incident to remelting and pruning out the rosin. At the Baldwin Locomotive Works, rosin filling gave way to sand, and the sand was displaced in some instances by coils of steel wire, preferably of square section, the coil of spiral spring being attached to a rod to adjust the spring to the part to be bent."

*Chem. News, 1902, 85, 134.

METALLOGRAPHIC DEPARTMENT.

In this department we will prepare articles on the subject of Printing from Metals in reply to any questions asked by our readers. Address THE METAL INDUSTRY, 61 Beekman Street, New York.

A NEW DRY POINT METHOD FOR DRAWING UPON ALUMINUM PLATES.

By Emanuel F. Wagner.

The beautiful but difficult method of etching on copper plates, by using a varnish, and drawing with a fine point through this medium, and finally biting in with nitric acid can only be carried out by a person who has had considerable experience in, or understanding the nature of copper or steel plates, and who is thoroughly conversant with the use of acids. In addition to that it takes years of practice to judge of the strength of line before the plate is inked in and an impression is made, which often proves sorely disappointing to the best artist and etcher.

We find that we have in aluminum plates a simple and efficient means for carrying out dry pencil etching, that is, a drawing method for producing the effect of an etching, or an elaborate pencil drawing, without the use of a varnish etch ground nor without the use of biting-in, and to which can be added or taken away without trouble or technical skill. It is an ideal system for artists who are not engravers or technicians to produce direct printing plates, of their original drawings, which may have been taken from nature or deliberately carried out drawings which will then have all the appearance of painfully executed engravings.

The method is the following: A finely grained aluminum plate is etched (these plates can be procured, ready etched by applying to some lithographic establishment using aluminum plates, as Sackett & Wilhelms Lithographic Company, Brett Lithographic Company, etc.) The etching preparation must be thoroughly rubbed off with a cloth before drying-in and the drawing is carried out with very hard pencils, say 6H. Several of these pencils of different degrees of sharpness should be handy for finer or coarser lines, the strokes must be firm, for they must take off the very fine film of gum which still remained from the etching preparation, and if this film is not scraped away with the point of the pencil, the line will not print later on.

The drawing, when completed, can be taken to the lithographic establishment for the purpose of taking proofs and we will here give the full directions for the printer to handle such art plates. The original preparation of the plate should be accomplished with a solution of an 80 per cent. (thick) ortho-phosphoric acid. This is reduced with water to 20 per cent. and mixed with gum which was dissolved, say, two-fifths gum arabic in three-fifths water. Now take two parts of this gum and add to it one part of the above phosphoric acid solution. The plate is then covered evenly with this mixture, using a sponge for its distribution, but instead of allowing it to dry the printer should rub off the preparation as well as he can with a partially damp, but perfectly clean cloth. The result will be that a very fine film of gum and acid will remain on the plate which, wherever broken by the sharp strokes from the hard pencil, will lay the plate bare and make it suitable for the following further manipulation when the printer gets the drawing back for making the proofs.

The plate is slightly warmed and then covered with lithophine or black rubbing-up composition, explained before in these columns. After drying off the same, the plate is washed with water (not cold) and rolled up and proofs taken. Should anything be added the plate must be gummed thinly and rubbed off as originally, before again drawing, and additions can be made, then the same process as before must be gone through by the printer.

These art plates can only be used for a few hundred impressions, but of course they could be transferred to other plates and impressions duplicated to any number.

ROLLERS FOR PRINTING FROM ALUMINUM PLATES.

By E. F. Wagner.

It has often been stated that rubber rollers should be used exclusively on aluminum plates, but this is an error; the best rollers for rolling up or proving blacks or full and heavily drawn color plates in the hand press are the usual leather rollers, and if large plates are to be operated upon, then the roller should be as large as possible. For tints and colors the rubber rollers are undoubtedly good, but all the work from aluminum can be printed with grain leather rollers. In the steam press the form rollers should be covered with rubber hose, or the rubber should be cast at once around the iron spindles. The use of rubber here is a question of economy; for the rubber rollers can be cleaned easily, whereas the grained leather rollers are washed up for a different color with great labor and expense of material, unless such presses can be kept running on the same color most of the time. Besides, by proper care the rubber rollers will last longer than those of leather.

In cleaning the rollers, kerosene is better than benzine or turpentine, as the latter will dissolve the rubber; even the use of the kerosene will have a deteriorating effect on rubber, and we should therefore recommend a solution of potash as best. Of course it is superfluous to caution the printer against allowing the ink to become hardened on the roller, as then the removal of same becomes a source of trouble and the roller may have to be "turned" off. The cleaning of rollers has been robbed of late of many of its drawbacks, by the roller-washing machine, which does the work of cleaning rollers at a great saving of time and expense in material, besides producing results superior to the old-fashioned cleaning by hand.

DAMPING THE ALUMINUM PLATE.

By E. F. Wagner.

During the operation of printing from aluminum plates the damping of it forms a conspicuous part of the process. The all-important thing necessary is to obtain an even distribution of the water over the plate. This is done by using a sponge if drawings are before you which represent large color plates drawn with the crayon upon a coarse grain for smooth plates a piece of netting, formed into a pad is better. A small sponge is used to bring a touch of water on some part of the plate, from whence it is then spread over the surface with a few quick and well calculated sweeps. The rolling up should follow immediately so as not to allow the water to dry off. The plate must always remain under moisture and no part thereof should be allowed to dry up. Should for any reason printing be stopped and if only for a short time then it is better to gum the plate first.

In the steam press the damping apparatus must be kept clean, and it should be the aim of the pressman to make his impressions with as little water as possible; all admixtures to the damping water such as sugar, glycerine, salt, acid, etc., must be done with the greatest circumspection, for in the most cases these admixtures produce more trouble than benefit. Never leave ink or damping rollers rest upon the plate during an intermission of printing.

INDIAN REPOUSSE WORK.

The metal workers of the South of India are noted for the skill with which by comparatively crude and clumsy methods they fashion the shapely vessels of brass and copper which forms so important a part of the worldly possessions of the average Hindu family. There are many thousands of such artizans, and not a few capable of much higher flights of skill, in which their craft is raised to a pitch of artistic excellence which compels unqualified admiration. In the numerous temples scattered over the southern districts of the Madras Presidency may be seen the finest examples of the coppersmiths art, produced by generations of men who lived for the sake of their work and were content that they should spend themselves in the decoration of those marvellous monuments of the religious sentiments which pervade Hindu life.

Times have changed, and under the stress of modern conditions of life the descendants of these craftsmen of the past have deteriorated, and, stimulated by dealers, globe trotters and art ware merchants, they have turned their attention to the production of silver work of a very inferior description. In the neighborhood of the temples there are yet a few who still retain the hereditary skill of their fathers, and of late years the authorities in the School of Arts at Madras have made a not altogether unsuccessful attempt to revive the old skill and adapt its productions to the exigencies of modern times.

In this present note I am only concerned with bringing to notice the various forms of copper repoussé work which can still be produced. The design is first sketched out full size on a sheet of paper and then transferred to the copper by tracing out the main outlines with a centre punch. The portions to stand out in relief are then beaten out as far as possible and after careful annealing the sheet of copper is embedded in lac, made from dammer and gingelly oil, with the back uppermost, and on this plastic bed the full relief requisite is obtained by beating with a flat punch. The plate is then removed, annealed and replaced on the bed of lac with the face uppermost, and the rough surface produced by hammering from the back is finely tooled and finished. The completed work is removed from the lac, cleaned and rubbed at intervals with cocoanut oil which gradually produces a permanent bronze on the surface of a soft and pleasing

tone. The bulk of the work done in the School of Arts is in the form of flat panels, which are worked up into screens, door frames, cabinets, sideboards, and so forth, but vases, bowls, and pots of a great variety of shapes are also made.

It may be interesting to note that aluminum lends itself very readily to the production of exceedingly fine repoussé work, as the extreme malleability of the metal allows of very great relief and consequent boldness being obtained, but unfortunately the hard white color of the metal renders the effect unsatisfactory. A good deal of such work has been done in aluminum and some very fine specimens were exhibited by the British Aluminum Company at the Paris Exhibition, but of late we have gone back to copper, and an attempt is now being made to bring prominently forward this extremely artistic decorative work at the Delhi Durbar Exhibition, which will be held in January, 1903.

The repoussé work being in very high relief involves a considerable amount of labor, and is consequently expensive. Good panels cost on an average $5 a square foot. The accompanying photographs illustrate a copper panel of a rosewood sideboard, the central figure of which is Subrahmanya, the second son of Parama Siva, the third member of the Hindu trinity, riding on a peacock. The whole figure is hammered out and is a fine piece of work. Also, a copper jar decorated in repoussé with conventional floral designs.

ALFRED CHATTERTON.

A writer in the New York *Sun* says: "A large number of tempered copper tools and utensils have been dug up from the sand near the entry to the Portage Lake Ship Canal on Lake Superior. The collection so secured contains a number of tempered cutting tools, and one peculiar article, use unknown, has a stiff spring. The age of these articles may be a few hundred or several thousand years, but the copper was so treated that its peculiar properties of edge and resiliency have been imparted permanently."

CORRESPONDENCE DEPARTMENT

In this department we will answer the inquiries of readers who have shop and foundry problems in the working and casting of aluminum, brass and copper, their allied metals and alloys. Address all communications to THE METAL INDUSTRY, 61 Beekman Street, New York.

Q.—A correspondent wishes to be informed about the best pickle for brass sheet, and whether it is used hot or cold.

A.—A mixture of oil of vitriol and water is the common pickle used by brass manufacturers. The proportions need not be exact, and one consisting of nine parts of water and one part of acid is what is generally used. Pour the acid into the water and not vice versa when making up the pickle.

This pickle, which is the most satisfactory known, is generally used cold, but much better results are obtained by heating it. It then works much more quickly and thoroughly. The lead lining of the pickle tanks does not appear to be attacked any more readily by hot than cold pickle.

Q.—We use considerable amount of soft solder and have recently come to the conclusion that we might be able to make it cheaper than we can buy it. The work which we use it on requires that a low melting point should be possessed by the solder. Kindly inform us what proportions of pig tin and lead should be mixed to form such a solder.

A.—The alloy of tin and lead with the lowest melting point is one which consists of two parts of tin and one of lead. This melts at 180 degrees Fahrenheit, and is by far the best solder for ordinary use. In addition to its low melting point the surface cools with a smooth appearance and not with a rough one like some of the solders. The fact that the tin is in excess prevents its general use as the cost is much higher than the half and half alloy so universally employed.

Q.—Is there any harm in using iron skimmers and stirrers in melting aluminum? A subscriber asks this, as he has believed that certain bad results were caused by such tools.

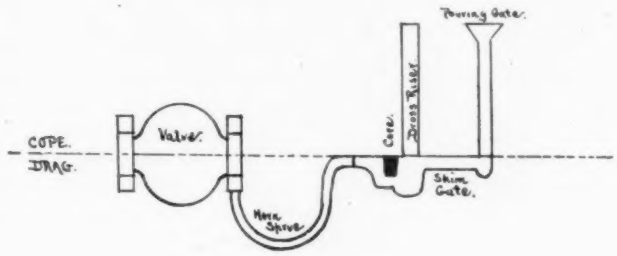
A.—Although iron will gradually dissolve in melted aluminum, the quantity which is taken up each time the stirrer or skimmer is put into the metal is so small that no harm follows. All aluminum contains a small amount of iron and the absorption of a small additional amount does not change the properties of the metal. An iron skimmer or stirrer last so long a time that the use of plumbago tools is quite unnecessary.

Q.—A foundry superintendent states that he has had difficulty with valves made of Government bronze (88 per cent. copper, 10 per cent. tin, and 2 per cent. zinc) leaking when a pressure of 300 or 400 lbs. per square inch is applied. He wishes to know of a mixture which will stand this pressure.

A.—The difficulty is not with the mixture, but in the casting, that is provided that the walls of the valve are not too thin. The fact that some valves stand the pressure while others leak indicates that the valve is properly designed. To obtain castings which will not leak requires that the metal should be melted under a good layer of charcoal and not allowed to overheat or "soak" in the fire. The greatest difficulty, however, is keeping the dross or oxide from getting in the mold with the metal. A casting to stand pressure requires perfect metal. Small amounts of oxide or dross which, in ordinary castings could scarcely be seen causes the metal to leak or "sweat" under pressure. The reason for it is that the oxide prevents a perfect union of metal and, acting like so much dirt, forms a channel through which water may pass.

There are two methods to guard against this, but we have been accustomed to combine the two and we know of some large valve makers who also follow the practice and obtain excellent results. The methods are as follows, viz.:

1.—By the use of a suitable skim gate in combination with a horn sprue. Any molder appreciates the value of a horn sprue, but we have found that many are ignorant of the existence of such a thing as a skim gate. The Renshaw skim gate* has been used by the writer for a long time with excellent results. The following sketch will indicate the manner in which the skin gate and horn sprue are used.



Although good results may be obtained with the skim gate alone, yet we have had better luck with the combination of the two. The casting should be gated on the flange or hexagon, either on the face or side, as desired.

2.—By the use of a small quantity of phosphorus. Such an addition, if not added in excessive amounts, acts favorably and prevents oxide forming on the surface. The average foundry man is apt to add too much and so have other troubles added to his difficulties. We have found that only 0.02 per cent. of phosphorus is all that is required. This is best added in the form of phosphor-tin. To get the required amount of phosphorus, add a half pound of phosphor-tin (containing 5 per cent. of phosphorus) to one hundred pounds of metal. The phosphor-tin should replace the same amount of ordinary tin. That is, if ten pounds of tin are usually taken to one hundred pounds of metal, then nine and one-half pounds should only be used with the half-pound of phosphor-tin. In other words, if Government bronze is desired and it is necessary to add the phosphor-tin, then the following weights should be taken: Copper, 88 lbs; tin, 9.5 lbs.; phosphor-tin, 0.5 lb.; zinc, 2 lbs.

Stirrers and skimmers for use in melting should be made of wrought iron, and not of steel. The latter, even the low carbon varieties, becomes somewhat-red-short at the temperature of molten copper, and are liable to break off. The life of a wrought iron stirrer or skimmer, too, is much longer than that of steel on account of the dissolving action of the melted metal being less on it.

The progress made in copper refining is illustrated by a statement by J. Bucknall Smith, "Wire and its Manufacture," who says that the electrical conductivity of the first Atlantic cable laid in 1856 was only 50 per cent., while those made at a later date contain copper wire of 98 per cent. conductivity.

*Patterns for this skim gate are sold by dealers in foundry supplies.

PATENTS

Granted, December, 1902

715,211. Method of Treating Scrap-Metal.—John M. O'Connor, Port Washington, Wis., assignor to the Connorite Manufacturing Company, Port Washington, Wis. A method of utilizing German-silver scrap-metal, consisting in placing the same in a crucible, adding thereto a small quantity of a soft metal, such as lead, and subjecting the mass to a proper heat for a length of time sufficient to thoroughly mix and fuse the same into a homogeneous mass; then mixing therewith a small proportion of aluminum.

715,358. Manufacture of Various Articles from Copper or Copper Alloys.—George A. Dick, London, England, assignor to the American Brass Company, Waterbury, Conn. The process of making hollow bars, tubes and other tubular articles of copper or copper alloys consisting in heating the copper or copper alloy to a high temperature, and then forcing the same, in its heated and plastic condition from a pressure-chamber through a die and around a short mandrel thereat, cutting or dividing the metal during its passage to the die, protecting the cut surfaces from contact with the air and bringing such surfaces together again while so protected, in the die, under heavy pressure, so that they may again unite.

715,625. Process of Obtaining Metallic Aluminum or Other Metals by Electrolysis.—Girolamo Taddei, Turin, Italy, assignor to the Societa Italiana di Applicazioni Elettriche, Turin, Italy. A method of obtaining the metal aluminum from its oxid, which consists in first decomposing sodium chlorid at a high temperature and separating its elements, then passing the hot chlorin from the first step through alumina mixed with a carbonaceous substance, thereby producing, by reaction, carbonic oxid and aluminum chlorid, and then mixing with the hot, vaporous aluminum chlorid the hot, vaporous sodium from the first step, thereby producing, by reaction, sodium chlorid and aluminum in metallic form.

716,977. Process of Purifying Aluminum.—Edward L. Anderson, St. Louis, Mo., assignor to John A. Gilliam, trustee, St. Louis, Mo. Filed July 27, 1901. The process of finishing aluminum, which consists in treating the surface thereof with hydrofluoric acid, and removing from said surface during said treatment the gas thereby generated. The process of treating aluminum, which consists in subjecting the same to the action of a solution of calcium fluorid, nitric acid, and a chromate of a metal.

717,080. Metallic Surface Sheathing.—George D. Coleman, Boston, Mass., assignor to the Coleman Ship and Pile Coppering Company, East Orange, N. J. The metallic surface sheating consisting of an outer layer of comminuted metal or alloy, the particles of which are united together, and a binding-layer of soft metal or alloy mechanically attached to the surface to be covered and mechanically attached to the layer of comminuted metal or alloy.

The Coe Brass Company, of Torrington, Conn., have purchased extensive tracts of wood and timber in the northern part of Goshen, Conn., and also an additional tract in the southern part of the town of Litchfield. The use of wood for annealing is apparently to be continued for some time to come.

A new brass foundry will be built in the near future by the Colton Manufacturing Company, Montpelier, Vt. It will be used principally in the manufacture of saddlery hardware.

ALUMINUM DINNER PAIL.

A new utensil in aluminum is the dinner pail shown in cut, which is marketed by The Aluminum Cooking Utensil Company, of Pittsburgh, Pa. The pail consists of a coffee reservoir, food tray and pie tray. The pie tray, which fits into the top of the food tray beneath the cover, is not shown in the cut. It is the first seamless oval dinner pail ever made, and has marked advantages over others, as the aluminum will not rust and there are no joints to leak or cause trouble. It is light and sanitary and low-priced, considering the advantages in construction.

CARE OF ALUMINUM UTENSILS.

Aluminum is not superior to the human body, in that it must be cleaned to be kept in order. The statement is often made that aluminum does not tarnish. This is not strictly true. It tarnishes, however, much less than do the other metals with which it is commonly compared. If an aluminum utensil is set away where it is not kept clean and dry it may in time darken, and this darkening is largely due to the accumulation of dirt, etc., and to some extent also to chemical action upon the metal itself—a true tarnish. If, however, the same utensil is occasionally washed and rubber there should never be any perceptible discoloration. The first important step, therefore, in the case of aluminum utensils is to keep them clean and dry when not in use. Wash each utensil well in hot water and plenty of soap-suds, dry with a cloth and place empty upon the hot stove for a few minutes. The object is to dry quickly and thoroughly. Ordinarily such care will be sufficient to keep the utensil in perfect order.

There are a few things which are enemies of aluminum and must never be used in cleaning it. Never boil ashes, lye or other alkalies, such as soda, potash, ammonia, etc., in an aluminum utensil. These substances attack the metal and blacken it, and water containing any of them will affect the utensils in a similar manner. Water containing sewage or other contamination will discolor an aluminum utensil. This is largely due to the presence of ammonia. Should the utensils become discolored the fault lies not with the utensil, but with the water used. It should be looked upon as a valuable indication of the condition of the water and should teach the necessity of a good filter or other means of purification. The discoloration may be prevented by using water which has been previously well boiled. This should always be tried when there is any trouble.

For cleaning aluminum utensils wash with soapsuds and hot water, rinse and dry as already described. Should anything adhere, instantly pour hot water into the utensil and let it stand to cool. Should it be necessary, scour the inside with bath brick dust or Sapolio. Use any good silver polish for the outside.

The Frank Mossberg Company, of Attleboro, Mass., are sending out a circular announcing that they are experts in the designing and building of sheet metal machinery.

"Everything you need in your foundry" is the slogan of The S. Obermayer Company, of Cincinnati, Ohio.

TRADE NEWS

The Chase Rolling Mill Company, of Waterbury, Conn., are completing the construction of their brass mill.

The Ansonia Brass and Copper Company are about to make extensive alterations in their copper mill at Ansonia, Conn.

A four-story factory is being built for Platt Brothers & Co., manufacturers of metal buttons, etc., at Waterbury, Conn.

Francis Keil & Son, of New York, manufacturers of brass goods, are putting up a four-story addition to their factory building.

The new plant of The Lunkenheimer Company, valve manufacturers, of Cincinnati, Ohio, occupies three acres of ground and gives employment to 700 men.

A new catalogue has been issued by the Billings and Spencer Company, of Hartford, Conn., who manufacture drop forgings in aluminum, bronze and copper.

The Illinois Brass Foundry Company, of Chicago, have been incorporated with $10,000 capital by G. F. B. Miller, A. F. Hammann and August C. Waschow.

It is announced that after January 1st, 1903, The Illinois Metal Company, of Granite City, Ill., will be in a position to quote the trade on pig lead, antimony and block tin in small quantities.

The Model Brass Company, of Kalamazoo, Mich., have been incorporated, with a capital stock of $5,000 by George Polosky and Samuel B. Meyer, of Kalamazoo, and Meyer J. Franklin, of Battle Creek, Mich.

The Rudolph and Summerill Tubing Company, of Philadelphia, Pa., manufacture seamless tubing in steel, copper and aluminum. They manufacture aluminum tubing in sizes from ½-inch down to 1-64 of an inch, in any gauge.

The James M. Somers Company have been incorporated at Bridgeport, Conn., with a capital stock of $15,000, for the manufacture of printers' brass rules. The officers are: President, George E. Somers; secretary and treasurer, James M. Somers; directors, George E. Somers, James M. Somers and Matthew Paulson.

The manufacturers of metallic phosphoro, The New Era Manufacturing Company, Kalamazoo, Mich., report that their product is growing in popularity as a brass founders' flux. Metallic phosphoro increases the chemical affinity between the different metals, thereby securing a complete and perfect union of the mixture. The flux is now in general use throughout this country, and is being used to some extent by foreign brass founders.

The Florence Manufacturing Company, of Florence, Mass., have had their usual large trade in holiday goods.

Among the new goods produced by the New Jersey Aluminum Company, of Newark, N. J., is a leader box for holding the flys and hooks of the fisherman.

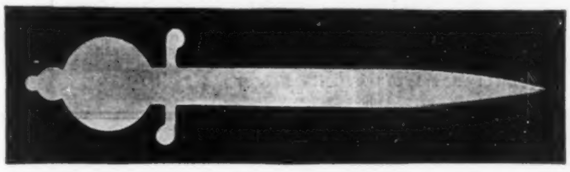
The Aluminum Manufacturing Company, of Two Rivers, Wis., report a particularly brisk holiday business and the production of several new novelties which will soon be ready for the trade.

L. F. Altpeter, of Chicago, Ill., writes us that he has invented a flux for his aluminum solder which makes it flow as easily as the half and half tin-lead solder. With his new solder Mr. Altpeter says he can unite aluminum so that it is impossible to tear the pieces apart, excepting by holding over a flame until the solder melts.

The Manitowoc Aluminum Novelty Company, of Manitowoc, Wis., write us that the business of their company for the season just ended has been a record breaker in both their regular line and in advertising souvenirs. The company believe the outlook for 1903 is excellent, and they are putting in additional comb machinery for their advertising department.

LETTER OPENER

The Fletcher Aluminum Company, of Springfield, Mass., is always getting out new novelties, and their latest



is a letter opener shown in cut. It is neat and attractive, and the company believe will be a good seller. They will issue soon a new catalogue.

SALE OF THE BAY STATE PLANT.

An important event in the aluminum industry is the sale of the Bay State Aluminum Company, of Quincy, Mass., to the Buckeye Aluminum Company, of Doylestown, Ohio. The sale includes the property, machinery and good will of the Bay State plant, which is to be moved to Doylestown. The Buckeye Aluminum Company have been incorporated under the laws of the State of Ohio with $50,000 capital. They have acquired a building site at Doylestown 200x105 feet, and are erecting a two-story factory measuring 100x40. The plant is to be finished by the first of June. The company will manufacture utensils and specialties. The Bay State Company will continue to operate their plant in Quincy until the removal to Doylestown, and Mr. Leon Ward, who for years has been superintendent of the Bay State plant, will become the general manager of the Buckeye works. The officers of the Buckeye Aluminum Company are: W. A. Huffman, Doylestown, Ohio, president; D. Forest Williams, Ithaca, N. Y., vice-president; W. R. Miller, Doylestown, Ohio, secretary-treasurer.

Metal Prices, January 10, 1903

PRICE LIST FOR SHEET COPPER.

Prices in Cents per Pound, Net.

Not wider than	Not longer than	And longer than	64 oz. & over, 50 lb. sheet, 30 x 60 and heavier	32 oz. to 64 oz. 25 to 50 lb.	24 oz. to 32 oz. 18¾ to 25 lb.	16 oz. to 24 oz. 12½ to 18¾ lb.	14 oz. and 15 oz. 11 to 12½ lb.	12 oz. and 13 oz. 9½ to 11 lb.	10 oz. and 11 oz. 7¾ to 9½ lb.	8 oz. and 9 oz. 6¼ to 7¾ lb.	Lighter than 8 oz.
Ins.	Ins.	Ins.									
30	72	....	18	18	18	18	19	20	21	24	27
30	96	72	18	18	18	18	19	21	24	27	
30	....	96	18	18	18	18	20	24			
36	72	....	18	18	18	18	20	22	25	28	
36	96	72	18	18	18	18	20	24	27		
36	120	96	18	18	18	19	21				
36	....	120	18	18	19	20					
48	72	....	18	18	19	20	22	25	28		
48	96	72	18	18	19	21	23	26			
48	120	96	18	18	20	22	26				
48	....	120	18	19	21	24					
60	72		18	18	19	21	24	29			
60	96	72	18	18	20	22	27				
60	120	96	18	19	21	24					
60	....	120	19	20	22	26					
72	96	....	18	19	21	26					
72	120	96	18	20	23	28					
72	....	120	19	21	26						
108	96	....	19	22	25						
108	120	96	20	21	24						
108	....	120	21	23	27						
Wider than 108	132	. ..	22	24							
	....	132	23	26							

Rolled Round Copper, ⅜ inch diameter or over, 18 cents per pound. (Cold Drawn, Square and Special Shapes, extra.)

Circles, Segments and Pattern Sheets three (3) cents per pound advance over prices of Sheet Copper required to cut them from.

All Cold or Hard Rolled Copper, 14 ounces per square foot and heavier, one (1) cent per pound over the foregoing prices.

All Cold or Hard Rolled Copper, lighter than 14 ounces per square foot, two (2) cents per pound over the foregoing prices.

Cold Rolled and Annealed Copper, Sheets and Circles, wider than 17 inches, take the same price as Cold or Hard Rolled Copper of corresponding dimensions and thickness

All Polished Copper, 20 inches wide and under, one (1) cent per pound advance over the price for Cold Rolled Copper.

All Polished Copper, over 20 inches wide, two (2) cents per pound advance over the price for Cold Rolled Copper.

Planished Copper, one (1) cent per pound more than Polished Copper.

Cold Rolled Copper prepared suitable for polishing, same prices and extras as Polished Copper.

Tinning.

Tinning Sheets, on one side, all sizes, per square foot, 2⅛ cents.

For Tinning Sheets, both sides, double the above price.

For tinning circles and segments, price is 2⅛ cents per square foot upon the square of the circle, *i.e.* a 12 inch circle is considered one square foot.

For tinning the edges of sheets one or both sides, price shall be the same as for tinning all of one side of the specified sheet.

PRICE LIST FOR ROLL AND SHEET BRASS.

Prices are for 100 lbs. or more of sheet metal in one order. Brown & Sharpe's Gauge the Standard.

Common High Brass	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
Wider than and including	2 12	12 14	14 16	16 18	18 20	20 22	22 24	24 26	26 28	28 30
To No. 20 inclusive..	.22	.23	.25	.27	.29	.31	.33	.36	.39	.42
Nos. 21, 22, 23 and 24	.22	.24	.26	.28	.30	.32	.34	.37	.40	.43
Nos. 25 and 26........	.23	.24⅛	.27	.29	.31	.33	.35	.38	.41	.44
Nos. 27 and 28........	.23	.25	.28	.30	.32	.34	.36	.39	.42	.45

Add ½ cent per lb. additional for each number thinner than Nos. 28 to 38, inclusive.

Add 7 cents per lb. for sheets cut to particular lengths, not sawed, of proportionate width.

Add for polishing on one side, 40 cents per square foot; on both sides, double this price.

Brazing, Spinning and Spring Brass, 1 cent more than Common High Brass.

Extra Quality Brazing, Spinning and Spring Brass, 2 cents more than Common High Brass.

Low Brass, 4 cents per lb. more than Common High Brass.

Gilding, Rich Gold Medal and Bronze, 7 cents per lb. more than Common High Brass.

Discount from List, 35 per cent.

PRICE LIST FOR BRASS AND COPPER WIRE.

BROWN & SHARPE'S GAUGE THE STANDARD.	Com. High Brass	Low Brass	Gilding Bronze and Copper
All Nos. to No. 10, Inc....................	$0.23	$0.27	$0.31
Above No. 10 to No. 16..	.23⅛	.27⅛	.31⅛
Nos. 17 and 18........................	.24	.28	.32
" 19 and 20........................	.25	.29	.33
No. 21........................	.26	.30	.34
" 22........................	.27	.31	.35
" 23........................	.28	.32	.36
" 24........................	.30	.34	.38

Discount, Brass Wire, 35 per cent.; Copper Wire, net.

METALS.

Tin—Duty Free.	Price per lb.
Straits of Malaca........................	28.00
Copper—Duty Free.	
Lake	12.50
Electrolytic	12.25
Casting..................................	12.25
Spelter—Duty 1c. per lb.	
Western	4.70
Lead—Duty Pigs, Bars and Old 2⅛c. per lb.	
Pig Lead	4.15
Antimony—Duty ¾c. per lb.	
Cooksons	8.75
Hallets	7.50
Other	7.00
Nickel—Duty 6c.. per lb.	
Large lots	40 to 50
Small lots	50 to 60
Bismuth—Duty Free....................	$1.50 to $2.00
Phosphorus—Duty 18c. per lb.	
Large lots	45
Small lots	65 to 75
	Price per oz.
Silver—Duty Free—Commercial Bars...........	$ 0.48
Platinum—Duty Free	19.00
Gold—Duty Free	20.00

Quicksilver—Duty 7c. per lb. Price per Flask...	48.00
Zinc.—Duty, Sheet 2c. per lb.	
600 lb. casks 6¼c..................	Per lb. 6¾

PRICE FOR ALUMINUM BRONZE INGOTS.

	Per pound.
2½ per cent..........................	19c.
5 per cent..........................	19½c.
7½ per cent..........................	20½c.
10 per cent..........................	21½c.

Above prices are for lots of not less than 500 pounds.

Manganese Bronze, Ingots....................	16½c.
Phosphor Bronze, Ingots....................	15 to 18c.
Silicon-Copper, Ingots	34 to 36c.

OLD METALS.

	Cents.
Copper, heavy cut and wire....................	11½
Copper, ligh and bottoms....................	10¼
Heavy machinery composition..................	11¼
Brass, heavy	8½
Brass, light	6¾
Clean brass turnings........................	7½
Lead, heavy	4
Zinc scrap	3¾
Pewter, No. 1	19
Scrap Aluminus, sheet, pure..................	22 to 25
Scrap Aluminum, cast, alloyed................	16 to 20

THE LATEST PRICE LIST FOR ALUMINUM IN ALL FORMS

All prices are F.O.B. cars at factories of manufacturers

PRICE LIST FOR INGOTS.

Duty.—Ingots, 8 cents per pound; sheet and all partially manufactured metal, 13 cents per pound.

Aluminum guaranteed to be over 99.75 per cent. pure at special rates.

No. 1. Aluminum (guaranteed to be over 99 per cent. pure) in ingots for re-melting.
37 cents per pound in small lots.
35 cents per pound in 100 pound lots.
34 cents per pound in 1000 pound to ton lots.
33 cents per pound in ton lots and over.

No .2. Aluminum (guaranteed to be over 90 per cent. pure Aluminum, with no injurious impurities, for alloying with iron or steel), cast in ingots for re-melting. This metal is not suitable for alloying with brass or zinc or for making Aluminum castings, as it is alloyed with iron and silicon.
34 cents per pound in small lots.
33 cents per pound in 100 pound lots.
32 cents per pound in 1000 pound lots.
31 cents per pound in ton lots and over.

Nickel Aluminum Casting Metal, being pure Aluminum alloyed with less than 10 per cent. of nickel and other hardening ingredients.
39 cents per pound in small lots.
35 cents per pound in 100 pound lots.
34 cents per pound in 1000 pound to ton lots.
33 cents per pound in ton lots and over.

Special Casting Alloy, containing over 80 per cent. pure Aluminum.
35 cents per pound in small lots.
30 cents per pound in 100 pound lots.
29 cents per pound in 1000 pound to ton lots.
27 cents per pound in ton lots and over.

Sibley Casting Alloy, used where strength is required, but somewhat heavier than the other alloys.
Prices, same as Special Casting Alloy.

Granulated Aluminum Nos. 1 and 2, one cent per pound over price of ingots.

Powdered Aluminum 90c. to $1.00 per lb. according to quantity.

Aluminum Castings, price from 45 cents per lb. upward, in accordance with the number of castings, weight, cost of moulding, etc.

The shrinkage to be allowed in making patterns for aluminum castings is ¼" to the foot.

To obtain the weight of aluminum in castings, bars, sheets, etc., divide the weight of similar pieces of copper by 3.3, brass by 3.1, and steel by 2.9.

Price Per Foot of Seamless Aluminum Tubing.

(CHARGES MADE FOR BOXING.)

Outside Diameter in Inches.	THICKNESS OF WALL IN STUBS' GAUGE. No. 12.	No. 14.	No. 16.	No. 18.	No. 20.	No. 22.	No. 24.		Outside Diameter in Inches.
1-4	......	......	......	10	9	8	7		1-4
5-16	......	......	......	11	9	8	7		5-16
3-8	......	......	......	12	9	8	7		3 8
1-2	......	......	17	14	11	9	8		1 2
5-8	......	......	21	16	13	12	......		5-8
3-4	......	......	25	19	16	14	......		3-4
7-8	......	......	28	22	18	16	......		7-8
1	......	......	30	25	21	19	......		1 00
1 1-4	......	......	36	30	25	......	......		1 14
1 1-2	......	52	43	35	28	......	......		1 1-2
1 3-4	......	60	50	41	33	......	......		1 34
2	84	68	58	47	37	......	......		2 00

Orders of 100 to 500 feet 20 per cent. discount.
Orders of 500 feet or over 30 per cent. discount.
Cutting to exact length 15 per cent. additional.

Sawed bars in widths less than 2 inches, an additional charge of 6 cents over the cost of sheet Aluminum; in widths of 2 inches and over, additional charge of 3 cents over the price of sheet Aluminum.

PLATE AND SHEET PRICE LIST.—B. & S. GAUGE.

Prices are for 50 pounds or more at a time. Less quantities, 5 cents per pound additional. Charges made for boxing.

Wider Than... And Including...	*3 in. 12 in. in coils.	6 in. 14 in.	14 in. 16 in.	16 in. 18 in.	18 in. 20 in.	20 in. 24 in.	24 in. 30 in.	30 in. 36 in.	36 in. 40 in.	40 in. 45 in.	45 in. 50 in.	50 in. 55 in.	55 in. 60 in.	Polishing One Side.	Sat. Fin. without Lacquer. One Side.
No. 13 & heavier	......	42	44	44	44	44	47	47	47	48	48	49	50	2	6
" 14	......	42	44	44	44	44	47	47	47	48	48	49	50	2	6
" 15	......	42	44	44	44	44	47	47	47	48	48	49	50	2	7
" 16	......	42	44	44	44	44	47	47	47	48	48	49	50	2	8
" 17	......	42	44	44	44	44	47	47	47	48	48	49	50	3	9
" 18	......	42	41	44	44	44	47	47	50	51	51	54	57	3	10
" 19	......	42	44	44	44	44	47	48	51	52	52	56	59	4	11
" 20	42	44	44	44	41	46	49	50	52	53	53	58	61	4	12
" 21	42	46	46	46	46	48	51	52	58	59	62	65	......	5	14
" 22	42	46	46	46	48	48	51	55	59	61	64	......	......	5	16
" 23	42	46	46	46	48	48	51	57	60	64	......	......	......	6	18
" 24	42	46	48	50	50	50	53	59	62	......	......	......	......	6	20
" 25	44	47	49	51	51	51	54	61	......	......	......	......	......	7	23
" 26	44	47	50	54	54	54	59	......	......	......	......	......	......	8	25
" 27	44	48	52	56	56	57	62	......	......	......	......	......	......	10	28
" 28	44	48	54	56	57	57	64	......	......	......	......	......	......	11	32
" 29	46	49	56	58	60	60	69	......	......	......	......	......	......	13	36
" 30	46	50	58	60	64	70	77	......	......	......	......	......	......	15	40
" 31	48	52	60	63	68	76	......	......	......	......	......	......	......	17	44
" 32	50	54	62	66	74	82	......	......	......	......	......	......	......	19	50
" 33	52	56	......	......	......	......	......	......	......	......	......	......	......	21	57
" 34	55	60	......	......	......	......	......	......	......	......	......	......	......	25	66
" 35 & 36	1 67	Not wider than 6 in.	......	......	......	......	......	......	......	......	......	......	......	Polished two sides double above prices.	Satin Finish two sides double above prices.
" 37 & 38	1 98		......	......	......	......	......	......	......	......	......	......	......		
" 39 & 40	2 22		......	......	......	......	......	......	......	......	......	......	......		
" .003" to .0015"	2 42		......	......	......	......	......	......	......	......	......	......	......		
Less than .0015"	2 66		......	......	......	......	......	......	......	......	......	......	......		

Additional charge for slitting coiled sheet in widths less than 3 in. and flat rolled sheets in widths less than 6 in.
All columns except the first are for Flat Rolled Sheets.

Discounts as follows are given for sheet orders over 200 pounds.

200 to 1,000 pounds	10 per cent. off list.	
1,000 to 2,000 "	10 per cent. and 2 "	"
2,000 to 4,000 "	10 " " 3 "	"
4,000 pounds and over	10 " " 5 "	"

Sheets polished or satin-finished on both sides, double the price for one side.

SHEET ALUMINUM.

Stiffness.—Sheet is furnished in varying grades of stiffness from soft to hard. It is best in ordering to specify the grade of stiffness desired, and to state in a general way the purpose for which it is wanted.

Nickel Aluminum sheet is furnished with a tensile strength of from 35,000 to 40,000 pounds per square inch, and with an elastic limit of over 25,000 pounds per square inch. This metal has considerable spring and resilience. Its price is the same as for pure aluminum sheets of same size and thickness.

To obtain the relative cost of aluminum sheet to brass sheet, divide the aluminum price by 3.19; thus No. 20 gauge aluminum sheet at 42 cents per pound is the same price per square foot as brass sheet at 13.1 cents per pound (42 cents divided by 3.19 equals 13.1 cents).

Similarly to obtain the relative cost of aluminum sheet to copper sheet, divide the aluminum price by 3.332.

Drawn Rod and Wire Price List.—B. & S. Gauge.

Diameter B.& S.G'ge.	0000 to No.10	No. 11.	No. 12.	No. 13.	No. 14.	No. 15.	No. 16.	No. 17.	No. 18.	No. 19.	No. 20.	No. 21.	No. 22.
Price per lb	$ 38	38½	38½	0 39	39½	0 40	40½	0 41	0 42	0 43	0 44	0 47	0 52

200 lbs. to 30,000 lbs., three cents off list.
30,000 lbs. and over, four cents off list.